Information Technology and Libraries, Sept. 1994, v13, n3, p. 203-212.
ISSN: 0730-9295
http://www.ala.org/lita/ital/
http://go.galegroup.com/ps/i.do?id=GALE%7CA15787179&v=2.1&u=colu44332&it=r&p=AONE&sw=w

Expert systems in technical services and collection management

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Technical services operations have traditionally evaluated their effectiveness in terms of quantity--number of orders placed, number of serial issues checked in, number of titles cataloged. Recent budget cuts and technological changes have, however, required libraries to redefine effectiveness. Many have begun to adopt current management thinking, which considers an organization's ability to adapt to its environment in addition to quantitative measurements. The ability to adapt may be increased through the empowerment of staff to take control of issues and resolve them without extensive hierarchical intervention or approval. This decentralization of decision making enables library staff at all levels to respond rapidly and innovatively.

Frank D'Andraia notes another compelling issue that will affect the future of technical services. He predicts a major staffing crisis in academic libraries in the 1990s, for technical services in particular. The focus is now on knowledge skills rather than clerical skills. Staff work very independently and must understand the larger processes in addition to their specific tasks. Traditional clerical work has been replaced with more interdependent and varied automated tasks.(1) What technical services manager has not seen the increasing need for acquisitions staff who understand OCLC, or copy catalogers who can interpret acquisitions records?

One of the ways to capture and build on existing expertise is through the use of knowledge-based systems. Although there are exceptions, these systems are not in wide use in libraries today. Certain aspects of acquisitions, serials control, collection management, cataloging, and preservation are ideal candidates for artificial intelligence development. However, as the following remarks indicate, little has been done outside the cataloging arena to develop knowledge-based systems in these areas.

Knowledge-Based Systems

Background

What exactly are knowledge-based systems? Knowledge-based systems are the broad category of systems that use some knowledge to perform their functions. They need not use either heuristics (rules of thumb) or artificial intelligence techniques in performing their tasks. Knowledge-based systems may be as simple as an online personnel manual that is easier to use because it can be searched more efficiently. Intelligent systems are a subset of knowledge-based systems. They display intelligent behavior, but not necessarily at the level of an human expert.

The same online personnel manual may fit into the category of the intelligent system if it includes linkages from one policy to another, for example, between salary schedules and pay classifications. Expert systems, a more specific category, use heuristics to perform tasks previously done by human experts.(2) The "expert" version of the personnel manual would incorporate the personnel librarian's knowledge of classification to allow the novice supervisor to select the appropriate classification after answering a few questions asked by the system. In essence, a well-developed expert system should provide the same answers that an expert would give when approached with a particular problem.

Use

Expert systems have five primary uses: 1. To make existing expertise more readily available, particularly in multiple locations; 2. To reach new levels of expertise by accelerating complex problem solving; 3. To free the expert to handle difficult cases while the system handles the more routine ones; 4. To preserve expertise that might be lost through retirement or resignation; and 5. To enhance training through observation and analysis of the reasoning used by the system to reach its decisions.(3)

In more colloquial terms, "the computer can answer queries when the expert gets tired or takes a vacation; it doesn't forget key components when under pressure. A well-written and well-formulated expert system will perform consistently and 'mindlessly.'"(4)

Expert systems can be developed to function in a variety of roles within an organization. As a consulatant, the system provides consistent advice to specialists or serves as an advisor to less-experienced staff who need access to particular expertise. As a checklist, the system reminds the user of factors to be considered and prompts with questions related to the problem. As a trainer, the system can provide initial training to the less-experienced or improve the expertise of the experienced user. As a communicator, the system serves as a ready reference to information that can be easily located and crossreferenced. (5)

Appropriate Domains

How does a designer determine what would be an appropriate domain or problem for an expert system to address? The literature is fairly consistent in its definition of appropriate domains for expert systems: 1. The scope and domain should be quite finite and bounded. 2. The problem and its solution should have a logical structure, i.e., the solution should not depend upon the use of common knowledge or everyday know-how. 3. The problem should be repetitive, yet sufficiently complicated to warrant the effort of creating the program. One conventional standard is to tackle problems that would take an expert more than five minutes but less than thirty minutes to resolve. Make sure there is not another, more cost-effective way to offer the information. Very complicated problems should be left to the now-liberated expert. 4. The solution should be clear-cut and not involve opinion. (6)

One additional factor is uncertainty. If there are not a number of possible answers to a given question, then the problem is too simple for an expert system. A nonexpert would see that a group of possibilities were plausible solutions to the problem; the expert would be the person most likely to select the most promising solution. (7)

Components

The basic structure of an expert system includes a knowledge base, an inference engine, a user interface, and some form of explanatory capability to demonstrate the reasoning behind the conclusions. The essential components of the system are the knowledge base and the inference engine. The knowledge base must include all the information and strategies needed to solve the problem. The inference engine is the logic or reasoning portion of the system that enables it to use the knowledge base to reach conclusions. (8)

Knowledge Acquisition

Knowledge acquisition or knowledge engineering is the process of obtaining and organizing expert knowledge to build the knowledge base. This process is widely recognized as the bottleneck in the development of expert systems. Alberico and Micco suggest that reference librarians and catalogers have ideal skills to pursue the two portions of this process. Obtaining information through tact and interpersonal skills is well-suited to the skills of reference librarians, and catalogers are expert at organizing and classifying knowledge. (9)

Interviewing is the most common technique used to gather information from an expert. Observation of the expert at work can be used to supplement the interview process, but observation alone is rarely sufficient. The single greatest factor that handicaps the interview process is the expert's inability to explain or understand the thought processes used in the decision-making process. "Often the expert claims to 'just know' how to do certain things; and it's extremely difficult to reduce intuitive logic like that to a decision rule, or to relate it to other decision rules."(10)

Expertise is also a moving target--it changes on a regular basis. Just as the human expert has to keep up with changes in his field of expertise, the knowledge engineer's job is not complete once the first knowledge base is constructed. Knowledge bases must be continuously revised and maintained.

Methods

The inference engine was mentioned earlier as the logic or reasoning portion of an expert system. Ford identifies nine structures used in developing these inference engines: rule-based systems, semantic networks, frames, object-oriented systems, grammar rules, reasoning with uncertainty, blackboards, machine learning via automatic rule induction, and machine learning via neural networks.(11) Rule-based systems, which use rules as the main form of know ledge representation, are the simplest type of intelligent systems to develop and the most common inference engine used in expert systems for libraries. A rule-based system might be designed to do no more than indicate a library's opening hours, taking into account weekends, holidays, and end-of-term periods. The IF-THEN rules would be very clear-cut. For example: If today is a bank holiday or today is a Sunday, then the library is closed. If today is vacation and today is a weekday, then the library is open 9-5. (12)

Development Issues

There are additional development issues beyond selection of an appropriate domain and inference engine. Cost can be a deterrent. Staff time is the greatest expense entailed in developing an expert system, although the decision to hire external expertise or train staff internally will also increase the costs. However, more sophisticated software and more powerful hardware are bringing these costs down.

The selection of tools to be used in developing the system can significantly affect cost. Tools for expert systems development come in two varieties: programming languages and shells. To use a programming language, the designer needs to know how to write programs. Shells, by contrast, are often designed with the nonprogrammer in mind and require no programming knowledge. (A shell may be thought of as a knowledgebased system without the domain knowledge. The framework already includes the inference engine and the user interface. All the developer has to do is add the knowledge base and define the problem to be solved.) (13) A relatively simple system should not require an expensive shell. "Conversely, to attempt to use a cheap, rulebased shell to create a system requiring more sophisticated knowledge representations and reasoning mechanisms is likely to be very expensive in terms of staff time and frustration, and unlikely to result in a useful product."(14)

Most importantly, using a shell frees the developer to focus on the construction of the knowledge base. Carrington concludes that "using an expert system shell ...is about as difficult as learning a word processing program such as WordPerfect or Microsoft Word."(15) Both Quinn and Alberico and Micco(16) provide excellent guidance on evaluating expert system shells.

Applications

The primary reason for developing expert systems for technical services (acquisitions, serials, cataloging, preservation) and collection management is to bring the improvements that technology can provide to bear on existing tasks. As with the introduction of new management tools, such as Total Quality Management, if it helps the library provide better service or work smarter, it is worth exploring.

Cataloging

Excellent summaries of the first known expert systems in cataloging exist throughout the literature.(17) Jeng has provided much new information on understanding human interpretation of bibliographic data by analyzing two hundred title pages for visual and linguistic cues.(18) Researchers have also identified the deficiencies of various expert system methods, such as classification with simple rule-based systems.(19) Cataloging has long been considered a bottleneck in the process of attempting to get newly acquired material to the patron in a timely fashion. Thus, cataloging would seem to be fertile ground for the development of expert systems. Cataloging involves three basic activities: describing the item and choosing access points for names and titles, assigning classification numbers, and assigning subject headings. Most of the research to date has focused on the first activity, descriptive cataloging, because it uses a rulebased cataloging code, AACR2. However, as the following discussion of existing prototypes will confirm, AACR2 is now considered too unmanageable to be used in its entirety for a single expert system.

OCLC Automated Title Page Project

One of the most significant projects in cataloging is the OCLC Automated Title Page Project. OCLC's study examines the viability of scanning title page information into an automated cataloging system. The system would evaluate this data and produce a first-level bibliographic description as defined by AACR2. Three of the seven elements needed for the first-level description can usually be found on the front of the title page. The development and evaluation of this project resulted in only a moderate success rate, with 73 percent of the bibliographic elements being identified correctly by the system. Even so, OCLC was encouraged by the results and believes that it is feasible to automate much of the initial effort involved in descriptive cataloging. (20)

Anticipating that the currently limited sophistication and reliability of optical character recognition (OCR) will be improved, OCLC has continued to build upon its work with title pages. Stuart Weibel has developed a more complex system to automatically catalog and index the structural components of documents by using OCR technology to read text. The system identifies bibliographic components of the documents, such as author and title, as well as structural components, such as abstracts and indexes, and encodes the compoents in accordance with the Standard Generalized Markup Language (SGML). Weibel expects that the system will be able to produce descriptive catalog entries, to convert existing catalog cards to MARC records automatically, and to index documents for full-text retrieval systems. (21)

MAPPER

MAPPER is an experimental cataloging advisor developed by Zorana Ercegovac as her doctoral dissertation at UCLA. This prototype uses the domain of descriptive cataloging for maps, an expensive and complex portion of the cataloging process. MAPPER was developed for two purposes: to make expert advice available to novice map catalogers and to improve conventional instruction in map cataloging. The system is essentially an interactive tutor that asks specific questions to elicit information, advises, explains its decisions, and provides the MARC tags and subfields. After the session, it displays a completed catalog entry and asks the user to verify each element. (22) It integrates cataloging rules related to maps from Anglo-American Cataloguing Rules, Cartographic Materials: A Manual of Interpretation for AACR2, and Library of Congress Rule Interpretations, as well as expert knowledge from map catalogers at LC.

The system was tested by library school students who had completed the introductory cataloging class but had no other experience in map cataloging. Three cataloging tasks were tested: determining the person or corporate body responsible for the map, determining the title and statements of responsibility, and deciding on the elements to be included in the publication area. As expected, students assisted by MAPPER provided significantly better cataloging answers than those not assisted by MAPPER. (23)

Jeng's Title Proper Project

For her doctoral dissertation, Ling Hwey Jeng investigated the linguistic and typographical properties of two hundred title pages in order to construct an expert system that could correctly identify the title proper. Information on the title page was blocked into nine sections: author, author affiliation, edition, other title information, place, publisher, series, title proper, and year. (24)

ShelfPro

ShelfPro, developed by Karen Markey Drabenstott and others, addresses another aspect of the cataloging process--shelflisting.(25) Shelflisting is concerned with assigning a book number, as opposed to the class mark portion of the call number, to an item. The manual shelflisting process involves (1) examining the book itself, (2) answering questions about its relationship to other books in the collection, and then (3) deciding what device to give the book so that it will appear in its proper place on the shelf. The system asks questions concerning steps 1 and 2, then, based on the answers provided, suggests appropriate shelflisting devices for the book (step 3).

In actual practice, the cataloger must assign the class mark of the book in hand first. If the book falls within the classification section used for this prototype (computer science, QA75 to QA76.95), consultation on ShelfPro begins. To initiate the cuttering, the system prompts the user for the first letter of the principal author's surname. Once the system suggests the appropriate author Cutter number, the user is advised via an information window to check the shelflist to make sure the number is unique. The system also prompts for other characteristics of the book that would affect its shelflisting--whether it is a translation, a conference or congress proceeding, etc.

ShelfPro would save time and improve consistency if incorporated into a library's automated library system, particularly its online shelflist. Consistency of shelflisting would improve because everyone involved in the process would be answering the same sequence of questions. Practices traditionally passed on in internal memorandums or by oral transmission would be documented. The online shelflist would be available to every workstation, eliminating the need for a manual file. Finally, ShelfPro would automate the practice of creating author and topical Cutters from the printed Cutter-Sanborn tables.

CATALYST

CATALYST is a simpler, less sophisticated system developed at Strathclyde University that serves as a consultant to the cataloger on the choice and form of access points. The user moves through a sequence of menus that ask questions related to access points, such as whether the authorship is mixed, unknown, or shared. Based on the user's selections, the system responds with advice as to how the main entry should be made and whether additional entries are needed.

CATALYST does not produce a catalog entry but rather helps the user rapidly find and display the appropriate rules from AACR2 to generate the entry. The system is designed for both novice and expert catalogers and so must balance the amount of explanatory information given to provide enough for the novice without boring the expert. (26)

CATALYST is a good example of a system that is knowledge-based but cannot be considered an expert system. "It is more of a 'smart manual' than an expert system. Its knowledge is basically algorithmic rather than heuristic, and it could easily have been programmed using traditional, not knowledge-based, programming techniques."(27)

CatTutor

CatTutor, developed at the National Agricultural Library (NAL), is another hybrid system, better described as a hypertext training tool than as an expert system. Its primary goal is to educate novice catalogers in creating bibliographic records for computer files. The system incorporates portions of AACR2, second edition, 1988 revision; the MARC format for computer files; a glossary; sample bibliographic records; quizzes; and a mastery test. Specifically, CatTutor aims to familiarize the user with the specialized vocabulary of descriptive cataloging and computer files; to link related concepts in standard reference tools to enhance access to these tools, thereby facilitating cataloging; to simulate an actual cataloging environment by providing the users with a graphic representation of the item being cataloged; and to lead the trainee through the creation of cataloging records. (28)

The system was tested and evaluated at NAL and other institutions across the country. Sarah Thomas provides a detailed assessment of the effort and costs associated with the development of this prototype. Knowledge engineers and programmers invested a great deal of time in the project. A minimum of $125,000 was spent on the development and testing of the prototype alone. "To improve the prototype to the point that it could be used as an effective tool in libraries or library schools would require many additional hours. To create a tutorial that would cover the spectrum of cataloging training, including descriptive cataloging of formats other than computer files, subject analysis, classification, and authority work, would require a major commitment."(29)

The developers also concluded that few libraries have the technological environment to support the system as envisioned. It was imagined as a permanent reference tool that would be a component of each cataloger's workstation. In addition, there were persistent questions about whether the tools was intended for experienced or novice catalogers. As with CATALYST, experienced catalogers wanted much of the basic material removed. Novices still thought that the system was not clear enough and that it required more detail.

Developers of expert systems for cataloging have invested great effort in making AACR2 manageable or reducing it to manageable subsets. (Davies argues for extensive revisions of the cataloging codes to remove rules that rely on human judgment.) Even if the capital costs were too high for most libraries, installing such systems in the national libraries could dramatically improve the volume of material cataloged at those libraries, an effect that would ultimately trickle down, eliminating backlogs at the local level. Davies concludes that systems that serve an advisory role, as a sort of partner with the cataloger, are the simplest and most promising in the short run. However, where expertise is rare (as in the case of cataloging maps, the problem MAPPER addresses) systems which incorporate real expertise and not just the relevant AACR2 rules are the most useful. (30)

Davies draws a further conclusion that all in technical services would be wise to heed: The performance of automatic cataloging should be assessed primarily on the nature of the mistakes made. Do mistakes occur primarily in description, or do they affect information retrieval? And how easy are the mistakes to detect and put right?(31) Hjerppe and Olander speculate that only 20 percent of the cataloging done today poses problems for human or computer catalogers. "In such cases, great demands are placed on the cataloger in terms of wide cataloging experience, high level of education and knowledge in general, and profound knowledge of the cataloging code as well as local cataloging practice and tradition. The element of interpretation is increasingly important to 'fringe' cases, and this kind of expertise is also increasingly difficult to formalize to the extent required for computer manipulation."(32) They also conclude that a system to manage the standard cases of cataloging is within reach today, but would probably not be cost-effective for most libraries. However, such a system would free catalogers to address the problematic 20 percent of the titles and to extend the role of cataloging to include other pieces of the record, such as tables of contents, or to include cataloging for other resources, such as databases found on the Internet.(33)

Acquisitions/Serials Control

In their 1989 survey of artificial intelligence and expert systems in libraries, Hsieh and Hall identified twelve articles addressing applications in technical services. They note that the majority concern cataloging, speculating that this is due to the ease with which AACR2 rules can be manipulated. They rightly acknowledge that this is not the case in acquisitions, "where there are no set rules to guide the creation of expert systems."(34) Although acquisitions librarians would likely argue that there are some set rules, the basic assumption is valid. Since their study, at least two expert systems in acquisitions have been developed and reported in the literature.

Monographic Acquisitions Consultant

Pam Zager Rebarcak's Monographic Acquisitions Consultant was designed to eliminate the discretionary component in monographic vendor selection, replacing it with a more quantitative decision-making model. The system was also developed to support the library's philosophy of using multiple vendors for monographic ordering. Elements of the process addressed include selecting vendors or suppliers, determing what types of orders to send to particular vendors, and determining what special policies or procedures apply.

The expertise of the head of the firm order unit, a Library Assistant IV in the monographic acquisitions section, was captured through interviews and observation. During the knowledge acquisition process, a number of decision factors emerged that were subsequently built into the decision tree for the inference engine:

Is the publisher direct only?

Do we have a blanket order with publisher?

Do we have a standing order with publisher?

Is this a membership?

Is the publisher foreign?

Is the publisher a university press?

Is the publisher on our exchange list?

Is this an approval vendor?

Is the publisher scientific?

Is the publisher known as predominately trade? (35)

In addition to these factors, the knowledge base includes supplier addresses, messages and instructions, publishers, and performance variables derived from the ALA Guide to Performance Evaluation of Library Materials Vendors.(36) These variables include service, delivery time, accuracy, discounts, shipping and handling, and additional charges. The vendor's performance on each of these variables was weighted, resulting in a composite score reflecting how well the vendor had performed in the library's experience. In the selection process, the vendor with the highest score who can supply a given type of material is recommended. Once a certain number of orders has been sent to that vendor in a given time period, the vendor with the next highest rating will be selected instead, supporting the library's goal of using multiple vendors.

The system was validated in a small test of twenty orders that had previously been assigned to vendors by an expert. Fifteen of the vendors selected by the system matched the decisions made previously by the expert. The remaining five orders were for publishers that were not part of the system's knowledge base. A conversation with Pam Rebarcak and the study's functional expert, Jerie Schwartz, confirmed many of the problems articulated theoretically in the literature. Based on the costbenefit analysis done regularly by the library's assistant director for technical services, Dilys Morris, Schwartz was spending 20 percent of her time selecting vendors. Releasing Schwartz from this activity would thus free her to tackle larger problems. Rebarcak also encountered the classic problem of the expert not always being able to articulate her reasons for making a selection or the factors considered. Hardware problems and the constant need to maintain the knowledge base have precluded the system from being used in production. However, the system has replaced a huge manual file of vendor arrangements. (37)

Pennsylvania State University System

The expert system developed at Pennsylvania State University by Lynne Branche Brown determines whether a title requested for order would be received on any of the extensive approval plans maintained by the library. The receipt of books on approval plans is determined by a set of rules called the plan profile, which could be incorporated into an expert system. In addition, staff use a variety of sources of information which could be incorporated as knowledge bases into the system: (1) a list of publishers whose titles are received on approval, (2) a spreadsheet which identifies subject inclusions organized by LC class, (3) a list of contemporary authors whose works are received on approval, (4) a list of geographic coverage of the approval plan program, and (5) a vendor database which includes the vendor's treatment of each title (including nonsubject parameters such as academic level and publication type). Incorporating these sources into an expert system would make this data accessible to a wider audience of acquisitions personnel and subject selectors.

As with the Rebarcak system, the prototype was tested against twenty orders that had already been evaluated by the approval plan staff. Most of the titles were identified correctly by the system. Those that were not were traced to errors in logic in the rule base. For example, if the system reached an early conclusion, it did not test the title against later rules; changing the order of the rules corrected the error. Once again in this system, the need for continuous maintenance was evident. The system must be updated as changes are made in each profile, as, for example, when publishers are added or deleted.(38)

In summary, the work in acquisitions and serials control has focused on monographic vendor selection and approval plan receipts. Another possible application that warrants exploration is the extension of the existing predictive serials check-in systems. "The next step for these systems is for them to 'learn' about publication patterns of individual titles, and adjust claiming cycles, based on actual receipt dates, rather than a mathematically-derived length of time between issues."(39) Much effort is also being expended in some library acquisitions departments to monitor and approve license agreements for many of the new electronic products, such as CD-ROMs. Are there elements of this process that could incorporate the expertise of the legal services department at the institution? In the hypertext arena, libraries have developed information finders for the public. Could these be extended to the technical services area, incorporating, for example, "who to contact for what" documents? Such a system would bear some resemblance to the supermarket systems which enable the shopper to locate the aisle for a particular product.

Collection Management and Development

With the continual increase in number of publications and reductions in materials funding, it is more important than ever to select the best and most relevant material for the library's patrons. Johnston and Weckert provide two additional arguments for the capture of collection development expertise in expert systems. First, this expertise could be put to use in smaller libraries that could never afford the services of a full-time human expert. Second, larger libraries could use the system as a second opinion to improve consistency in the decision-making process. Collection development is also an appropriate domain because perfect results are not required, nor is it clear what perfect results would be in this area.

Selection Advisor

Selection Advisor, the system developed by Johnston and Weckert, uses six categories of selection criteria (in declining order of importance): subject, intellectual content, potential use, relation to collection, bibliographic considerations, and language. Issues within these categories are grouped into first, second, and third priorities. The system interacts with the user through a series of thirty questions for each book or journal being considered for purchase, for example: Is this a major critical study? Is it likely to be of research interest? Is it a popular treatment? Using the Prolog programming language, the system evaluates responses to these questions and recommends either purchase or rejection of the title.(40)

In practice, answering thirty questions per item would be too time-consuming. Practicing librarians confirmed for the authors that most decisions were made fairly quickly when scanning lists of titles from publishers. The system would provide no time savings for the selectors over the current method. "A more promising approach would seem to be that of tapping the information in electronic databases of publications, including synopses of content. It is here that the power of such a system scanning thousands of entries would become apparent. Even if such a system yielded results no more quickly, each individual result could reflect the sum of considerable assessment."(41)

Monograph Selection Advisor

Monograph Selection Advisor was developed by Steven Sowell at Indiana University. Sowell selected a narrow subject field--classical Latin literature--because its scope was primarily limited to the works of a few dozen writers and secondary works about those writers and their works. Knowledge acquisition came via interviews with bibliographers in this field, which included questions about basic information on the subject, research and teaching needs of faculty and students, selection sources, and budgetary constraints. Based on the interviews, each factor was given a weight to reflect its importance in the selection process. For example, secondary materials in particular languages were more important than works in other languages. A series of questions was developed based on these factors; based on the user's responses to these questions the system would make one of five recommendations: must be bought, should be bought, can be bought, should not be bought, or more information is needed.

The testing/refinement stage of this project was well designed and implemented. Examples were evaluated by the system and the expert. Where there were differences, the expert was interviewed and the system's weighting structure refined as appropriate. This cycle of testing and refinement continued until the developer was satisfied with the program's performance. Since the knowledge base in this area is relatively stable, little revision will be required on an ongoing basis except to reflect changes in the teaching and research interests of faculty and students. A subject area experiencing rapid change will require significantly more updating.

Like Johnston and Weckert, Sowell observed that the expert often took in the information at a glance, arriving at a selection decision much more quickly than the system could. He suggests that the system might be more effective using frames as opposed to the current rule-based scheme. Sowell reaches a conclusion similar to that of the developers of the Selection

Advisor: that an expert system could effectively review large quantities of machine-readable bibliographic information on newly published materials and make selection recommendations based on a library's specific knowledge base. Although similar to an approval plan profile, the system could be programmed and refined to exclude unwanted items. In addition, he sees a potential use for the system in the training of subject bibliographers, especially through full use of its ability to explain itself. Finally, he speculates that an expert system might be the most effective way of presenting collection development policies.(42)

Journal Expert Selector

Journal Expert Selector was developed by Roy Rada, editor of Index Medicus, to capture the expertise of human journal selectors at the National Library of Medicine who were making decisions as to which journals should be indexed in Index Medicus. The main criteria of the JES included (1) composition of the journal, (2) producers of the journal, (3) information in articles, and (4) authors of articles.(43) The JES contains thirty rules that interact with particular journal attributes. To operate the JES, an expert responds to each journal attribute, indicating the importance they assigned that attribute. Rada's evaluation of the first prototype can be generalized to other expert systems where those with expert knowledge may be threatened by the implications that a expert system might replace them. A set of rules was devised and tested, and the expert system performed reasonably well as a first prototype. The experts themselves were, however, generally reluctant to accept the possibility of any formal codification of their knowledge. The view is typical in situations where the experts have long practiced an art without needing to justify in detail the decisions rendered during that practice.(44)

The Bibliographer's Workstation

The Bibliographer's Workstation, developed by John Meador and Lynn Cline at Southwest Missouri State University, again represents the use of a hypertext tool rather than an expert system. The system models the four-step collection decision process: identification of material, evaluation, selection (or rejection), and acquisition. Each stage relies on different sets of data. The data in the Bibliographer's Workstation are organized into four groups: (1) bibliographic data, such as the library's local OPAC; (2) critical and contextual data, such as collection development policies and accreditation standards; (3) financial data, such as the library's materials budget allocations; and (4) commercial data, such as BIP+ or other vendor databases. The user can approach the system by working through the process of selection, by going directly to the needed data set, or by discipline. The current system is essentially a collection of data and databases linked through hypertext connections to databases accessible via the Internet. However, the developers envision the system's evolving into a tool for filtering bibliographic data.(45)

Collection development systems to date have focused primarily on providing information to enhance the selection process. As an acquisitions librarian, I can envision cases where these selection decisions could be captured to enhance the acquiring process. Not only could available bibliographic data be captured to avoid rekeying, but the thinking that resulted in the decision to buy could also be captured. For example, how much effort should be expended in locating a piece that is out of print? What is most important: getting the best price, getting an item quickly for use in a class, or getting a specific or first edition? But collection development and management includes much more than the selection process. Systems could be explored relating to journal cancellations, weeding or storage decisions, evaluation of the collection, and usage studies.

Preservation

Preservation activities are almost entirely unexplored territory in the expert systems area. The only evidence I can find of development in this area is a system known as CALIPR, marketed by the California State Library Foundation. This needs-assessment instrument provides some of the expertise of a preservation consultant "to help assess, quantify, and prioritize the preservation needs of your collection."(46) Collection development and management, along with acquisitions, serials, and preservation, have likewise received little attention in the expert systems arena; there is much new ground to be explored.

*** Conclusion**

Charles Bailey has articulated a number of the general barriers to the development of expert systems, such as cost, the tedium and difficulty of knowledge acquisition, the difficulty of natural language processing, problems in scaling up prototypes to operational systems, and the limited pool of artificial intelligence expertise in the library world. In addition, he discusses an issue he labels as "risk aversion." "When library administrators invest scarce resources in innovative projects, they usually expect success, preferably rapid success. Unfortunately the closer to the cutting edge a project is, the greater the chance that it will fail to produce a fully functional system."(47)

Librarians must also adjust their thinking about expert systems to match current thinking in the artificial intelligence world. According to Philip J. Smith of the Cognitive Sciences Laboratory at Ohio State University, the field has shifted away from the use of the term "expert systems," which are considered a failure, to the term "cooperative systems." Developers of cooperative systems acknowledge that it is very difficult to replicate with a machine what the expert actually goes through. Instead, developers take a task that an expert does, identify a piece of that task that the machine can assist with (typically 20 percent of the task), and develop a cooperative system around that aspect.(48)

Despite the number of articles written about expert systems, development in the library world has been limited, with almost no operational systems in wide-spread use. Bailey compares the development of expert systems to the development of home-grown automated systems and those marketed by vendors. When did everyone start buying automated systems? The answer is, once a few entrepreneurial libraries and vendors developed viable ones. Today, few libraries develop their own integrated library system; most buy a turnkey system from a vendor. This is the major reason why integrated systems are so prevalent today--each library does not have to build its own system. As long as we are in an era of hand-crafted intelligent systems, libraries will make limited use of these systems. We need turnkey intelligent systems, which can be modified for local use. As in the past, the source of these systems may be mixed, with both vendors and a few exceptional libraries producing systems that vendors can successfully market.

To accomplish this goal, vendors and a small number of progressive libraries will need to create powerful, transportable, and marketable intelligent library systems, based on the continuing advances made in the commercial AI [artificial intelligence] marketplace. (49)

With downsizing, "rightsizing," and the emergence of contracting out technical services, particularly cataloging services, to outside vendors and utilities, it is unlikely that libraries will devote much attention to developing expert systems for technical services, or that they will have the technological environment and the technological and technical services expertise for such projects. Instead, it will become incumbent on these new service providers to use developments in artifical intelligence to enhance their provision of these contract services. For example, a vendor may develop and provide an expert system application to the libraries using its services. The system would enhance the provision of information to the contractor to expedite the cataloging or acquisitions activities that they have assumed for the library. Ideally, these systems will be components of the library's integrated library system, so that information can flow seamlessly from one area to another. Thus, partnerships between providers of automated library systems and providers of technical services are essential to efficient use of expert systems in technical services.

It is important not to lose sight of the obvious: that artificial intelligence is nothing more than a tool having unique strengths and weaknesses. "Our true goal is not to create systems based on artificial intelligence technologies--it is to create the most powerful, flexible, and easy-to-use systems possible for ourselves and our patrons. AI is one tool in the toolbox, which should be employed when the characteristics of the task at hand indicate that an AI solution is called for."(50)

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